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CLAIMS:

1. A magnetic sensor device for determining the presence of at least one magnetic particle (15), the magnetic sensor device comprising:
 - a magnetic sensor element (11) on a substrate (10),
 - a magnetic field generator (12) for generating an ac magnetic field,
 - a sensor circuit (3) comprising the magnetic sensor element (11) for sensing a magnetic property of the at least one magnetic particle (15) which magnetic property is related to the ac magnetic field, characterized in that the magnetic field generator (12) is integrated on the substrate (10) and is arranged to operate at a frequency of 100 Hz or above.
- 10 2. A magnetic sensor device as claimed in claim 1, characterized in that the magnetic field generator (12) is arranged to operate at a frequency where the thermal white noise of the magnetic sensor element (11) is dominant over the 1/f noise of the magnetic sensor element (11).
- 15 3. A magnetic sensor device as claimed in claim 1, characterized in that the sensor circuit (3) comprises an amplifier being connected to the magnetic sensor element (11), and the magnetic field generator (12) is arranged to operate at a frequency where the thermal white noise at the output of the amplifier (21) is dominant over the 1/f noise at the output of the amplifier (21).
- 20 4. A magnetic sensor device according to claim 1 or 2, wherein the magnetic field generator (12) comprises a conductor and an ac current source for generating an ac current flowing through the conductor.
- 25 5. A magnetic sensor device according to 4, wherein the direction (30) of the ac magnetic field is mainly perpendicular to the plane of the magnetic sensor element in the direct neighborhood of the magnetic sensor element.

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6. A magnetic sensor device according to any of the previous claims, wherein the magnetic field generator (12) and the sensor circuit (3) form an integrated circuit.

7. A magnetic sensor device according to any of the previous claims, wherein
5 said magnetic field generator (12) and said magnetic sensor element (11) are positioned adjacent each other above a substrate (10).

8. A magnetic sensor device according to any of claims 1 to 6, wherein said
magnetic field generator (12) is positioned between said substrate (10) and said magnetic
10 sensor element (11).

9. A magnetic sensor device according to any of claims 1 to 6, the magnetic
sensor element (11) lying in a plane, wherein said magnetic field generator (12) is positioned
adjacent one side of the magnetic sensor element (11) and a further magnetic field generator
15 (12') is positioned on the opposite side of the magnetic sensor element (11) at a same position
with respect to a direction perpendicular (30) to the plane of the magnetic sensor element
(11).

10. A magnetic sensor device according to any of the previous claims, wherein
20 said magnetic sensor element is a magnetoresistive sensor element.

11. A magnetic sensor device according to any of the previous claims, furthermore
comprising means for determining a concentration of magnetic particles.

25 12. A magnetic sensor device according to claim 11, wherein the means for
determining a concentration of magnetic particles comprises a plurality of magnetic field
generators.

30 13. A magnetic sensor device according to claim 12, the magnetic sensor element
lying in a plane, wherein the plurality of magnetic field generators are located at different
levels with respect to the plane of the magnetic sensor element.

14. A magnetic sensor device according to any of the previous claims, wherein the
at least one magnetic particle is a magnetic label coupled to a biological molecule.

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15. A method for determining the presence of at least one magnetic particle (15),
the method comprising the steps of:

5 - generating an ac magnetic field in the vicinity of a magnetic sensor element
(11),

- sensing with the magnetic sensor element a magnetic property of the at least
one magnetic particle (15) which magnetic property is related to the ac magnetic field,
characterized in that the frequency of the ac magnetic field is chosen at 100 Hz or above.

10 16. A method as claimed in claim 15, characterized in that the frequency is chosen
at a value where the thermal white (Nyquist) noise of the magnetic sensor element (11) is
dominant over the 1/f noise of the magnetic sensor element (11).

15 17. A method as claimed in claim 15, characterized in that an amplifier (21) is
connected to the magnetic sensor element (11) and the frequency of the ac magnetic field is
chosen at a value where the thermal white noise at the output of the amplifier (21) is
dominant over the 1/f noise at the output of the amplifier (21).

20 18. A method as claimed in claim 15 or 16, characterized in that the direction (30)
of the generated ac magnetic field is mainly perpendicular to the plane of the magnetic sensor
element in the direct neighborhood of the magnetic sensor element.

25 19. A method as claimed in any of the claims 15 to 18, further comprising the
steps of:

- performing a calibrating measurement in absence of magnetic particles (15),
which calibrating measurement measures the magnetic field generated by the magnetic field
generator (12).

30 - using the obtained calibrating measurement value and subtract that value
from the actual measurement value obtained when a measurement is carried out in the
presence of magnetic particles (15).

20. A method for determining a concentration of magnetic particles as a function
of location of the magnetic particles by using the device of claim 9, wherein each of the
magnetic field generators (12) generates an ac magnetic field with a different modulation

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(20a, 20b) frequency, the output signal of the magnetic sensor element (11) is demodulated resulting in signals with different frequency, from which signals the number of magnetic particles and the position is determined.

5 21. A method for determining the surface concentration and the bulk concentration of the magnetic particles by using the device of claim 13, wherein the plurality of magnetic field generators generate an ac magnetic field component normal (30) to the in-plane directions of the magnetic sensor element (11), from which magnetic field component the position of the magnetic particles is determined.

10 22. A method as claimed in claim 21, wherein each of the magnetic field generators generate an ac magnetic field with different modulation frequencies, the output signal of the magnetic sensor element is demodulated resulting in signals with different frequency, from which signals the number of magnetic particles and the position is determined.

15 23. Use of a method according to any of claims 15 to 22 for molecular diagnostics biological sample analysis, or chemical sample analysis.